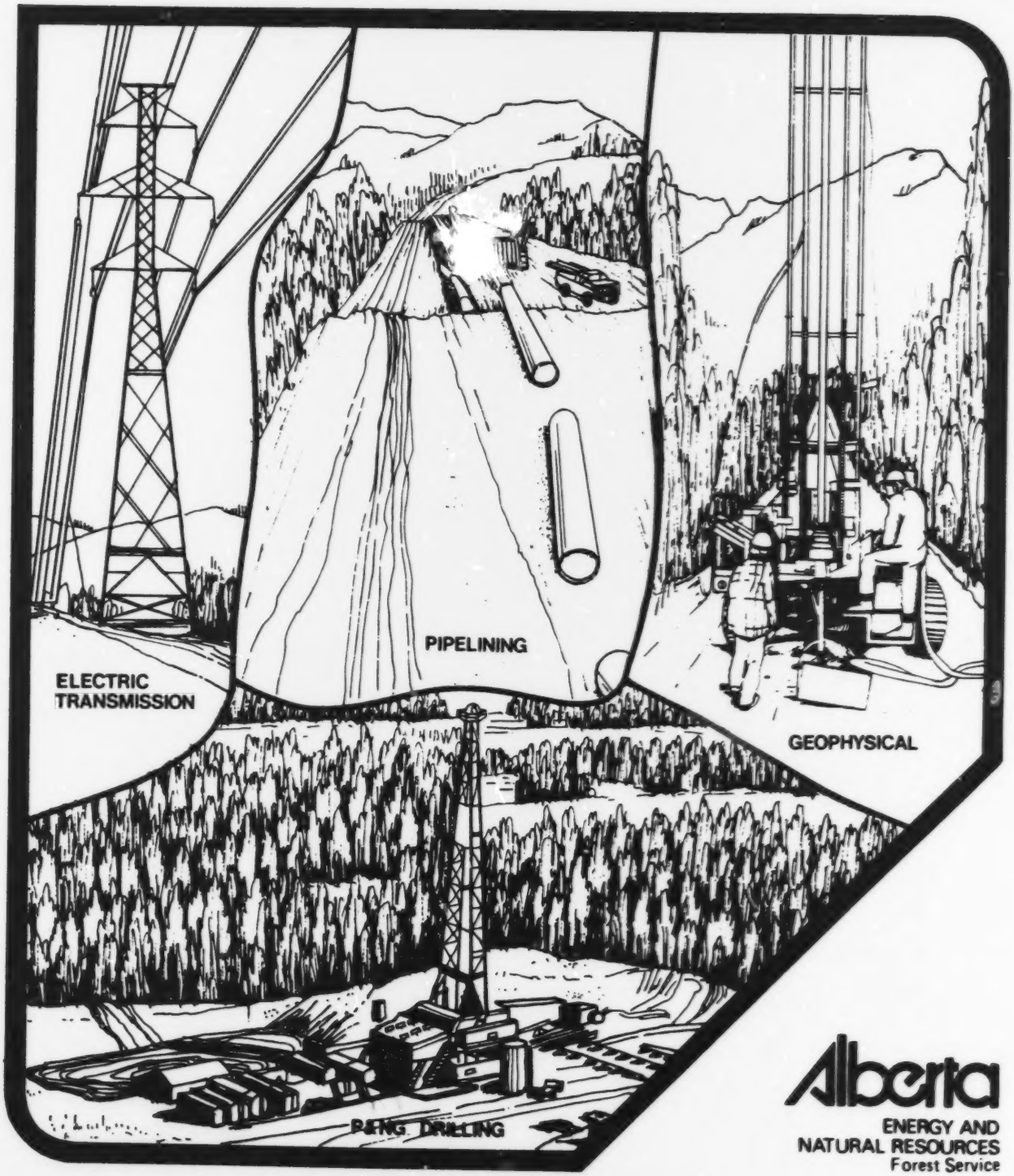
The Resource Handbook

Operational Guidelines For Industry



Alberta

ENERGY AND NATURAL RESOURCES

Forest Service

85-2863/

THE RESOURCE HANDBOOK OPERATIONAL GUIDELINES FOR INDUSTRY

Prepared by:
Forest Land Use Branch

Alberta
Energy and Natural
Resources
Forest Service

1984
Revised

ENR Technical Report Number: 75
International Standard Book Number: 0-86499-980-1

First Printing - January, 1979
Revised - 1984

RESTRICTED TO INDUSTRY

COPIES OF THE REPORT ARE AVAILABLE AT:

Alberta Energy and Natural Resources
Information Centre
Main Floor, Bramalea Building
9920 - 108 Street
Edmonton, Alberta, Canada
T5K 2M4
Phone: 403-427-3590

TABLE OF CONTENTS

Page

List of Illustrations v

Introduction vii

Map of Green Area ix

Part I EXPLORATION 1

Section 1 Specific Operating Guidelines 1
- a) Geophysical Operations 1
- b) Sand, Gravel, Clay and Marl 1
- c) Quartz Mineral 1
- d) Coal 2
- e) Core Hole 2

Section 2 Basic Requirements 3

Section 3 Timber and Debris Disposal 5

Section 4 Erosion Control 9

Section 5 Reclamation for Abandonment 15

Part II DEVELOPMENT 19

Section 1 Specific Operating Guidelines 19
- a) Licence of Occupation (Access Roads) 19
- b) Mineral Surface Leases (Wellsites) 19
- c) Pipelines 20
- d) Transmission Lines 20
- e) Sand, Gravel, Clay and Marl Quarry 20

Section 2 Basic Requirements for Development 20

Section 3 Timber and Debris Disposal 23

Section 4 Erosion Control 27

Section 5 Reclamation for Abandonment 33

Page

Glossary 37

Appendix A Area Described in The Forest and Prairie Protection Regulations Part II 41

Appendix B Grass Seed and Fertilizer Mixtures 42

Appendix C Sump Fluid Disposal Requirements 44

Appendix C1 Guidelines for Obtaining a Sample of Sump Fluids 48

Appendix C2 Guidelines Used to Determine Fish Toxicity Tests on Sump Fluids 49

Appendix D Metric/Imperial Table 50

Appendix E Conversion Table for Changing Degrees to Percent 52

LIST OF ILLUSTRATIONS

		Page
1.	Proper Stream Approach	3
2.	Hand Cut Seismic Line	4
3.	Buffering at Seismic Line Intersection	4
4.	Buffer Zone	4
5.	Basket Containing Portable Seismic Equipment	5
6.	Portable Drill in Operation	5
7.	Salvage Adjacent to Line	6
8.	Flare Cutting	8
9.	Debris Bulldozed to One Side	8
10.	Partial Brush Disposal	9
11.	Debris Scattered Back on Right-Of-Way	9
12.	Cross Ditching with a Bulldozer	10
13.	Cross Ditching	11
14.	One Way Cross Ditching	11
15.	Two Way Cross Ditching	11
16.	Cross Ditching on a Deep Cut Line	12
17.	Cross Ditching and Ditch Blocking on Deep Cut Lines	12
18.	Obstructions to Retard Runoff	12
19.	Berm Removal	12
20.	Cross Ditch Construction	13
21.	Cross Ditch Construction	13
22.	Cross Ditch Construction	13
23.	Cross Ditch Construction	13
24.	Cross Ditch Constructed by Hand	14
25.	Cross Ditch Constructed by Hand	14
26.	Bulldozer Tracks Create Microsites for Vegetative Establishment	15
27.	Recontouring	15
28.	Recontouring	16
29.	Recontoured Exploration Line in High Value Area	16
30.	Recontoured to Original Contour and Revegetated	16
31.	Landscaped to Original Contour	16
32.	Regenerated Disturbed Site One Year Following Seeding	17
33.	Slash Left on Slope	17
34.	Debris Scattered Over Right-Of-Way	17
35.	Same Site One Year Later	18
36.	Common Corridor	21

		Page
37.	Buffer Between a Wellsite and a Lake	21
38.	Buffer of Windfirm Trees Between Borrow Pit and Right-Of-Way for Roads	22
39.	Screening in High Aesthetic Areas	22
40.	Right-Of-Way Clearing Restriction When Crossing a Valley	22
41.	Variable Width Right-Of-Way to Accommodate a Slope	22
42.	Properly Constructed Dike on the Low Side of a Lease	23
43.	Diversionary Ditch Around the High Side of a Lease	23
44.	Prelogging a Right-Of-Way	23
45.	Salvaged Material Decked in an Approved Location	24
46.	Prelogged Right-Of-Way Before Construction	24
47.	Debris Disposal by Burning	25
48.	Total Disposal on a Pipeline Right-Of-Way	26
49.	Total Brush Disposal Using a Madge Rotary Landbreaker	26
50.	Total Disposal on a Pipeline Right-Of-Way	26
51.	Hydro-Axe Removing Young Growth	27
52.	Hydro-Axe Removing Young Growth	27
53.	Slope Stabilization	29
54.	Seeding and Fertilizing Carried Out Progressively	30
55.	Diversion Channels	30
56.	Ditch Block Using Timber and Rocks	31
57.	Ditch Blocks Using Rock and Gravel	31
58.	Ditch Blocks Using Straw Bales	31
59.	Culvert Placed Within a Stream Bed and Properly Rip-Rapped	32
60.	Raised Culvert Invert Results in a Barrier For Fish Passage	32
61.	Culvert Baffles	32
62.	Timber Bridge	33
63.	Landscaping of a Right-Of-Way	34
64.	Right-Of-Way Satisfactorily Recontoured	34
65.	Right-Of-Way One Year Following Seeding	34
66.	Spreading Stockpiled Material	35
67.	Site Successfully Recontoured and Seeded	35
68.	This Site Has Been Satisfactorily Put To Bed	35
69.	Successful Vegetation Re-Establishment	36
70.	Debris Spreading For Erosion Control and Revegetation	36
71.	Area Planted to Native Species	36

INTRODUCTION

This handbook was developed as a reference guide for field operations in resource-rich areas of the province. It was first published in 1979. It offers practical guidelines to help management in the industrial sector and forest service personnel work together under mutually-acceptable standards for resource protection and reclamation procedures.

The overall objective is to maintain a balance between necessary resource utilization for the economic well-being of the province and publicly-inspired environment protection demands.

The guidelines apply to areas where the Alberta Forest Service (AFS) has responsibility for establishing and enforcing conditions of approval on surface rights. These conditions relate to industrial construction, operation and maintenance and the abandonment phases of resource exploration and development.

The book is designed primarily to assist industry in planning their initial and on-going activities within current legislative and governmental policy requirements and is directed at standardizing methods used to achieve maximum and uniform results in different forest areas.

The contents are divided into two parts, Exploration and Development and further subdivided into five reference sections detailing specific guidelines, basic requirements, disposal of timber and debris, erosion control, and site reclamation for abandonment. The information deals with minimum standards required for locations within the provincial Green Area, with the exception of coal development.

Certain developments such as major pipelines, transmission lines and highways are subject to a comprehensive resource impact assessment. Once this evaluation is completed by the AFS and other resource agencies, and a final location selected, a resource protection plan is developed.

The overall guidelines contained in this handbook are directly applicable to the production of such a plan.

In historical sequence, the Government of Alberta announced a policy covering Resource Management of the Eastern Slopes in July, 1977 and revised July, 1984. This encompasses an area of approximately 90 000 km^2 predominantly forest-covered mountains and foothills. The region is rich in renewable and non-renewable natural resources which lie mostly within Crown lands. This includes water, timber, livestock and wild-

life forage, minerals and recreational land. The concern and conflicts over environmental quality, land use and allocations, as well as the present and future state of this vital watershed region, focused upon the need for an integrated land use policy and a comprehensive plan for management and development.

Copies of this policy are available from Alberta Energy and Natural Resources (see page ii). The conditions and constraints applicable to the zones designated within this policy take precedence over the guidelines contained here.

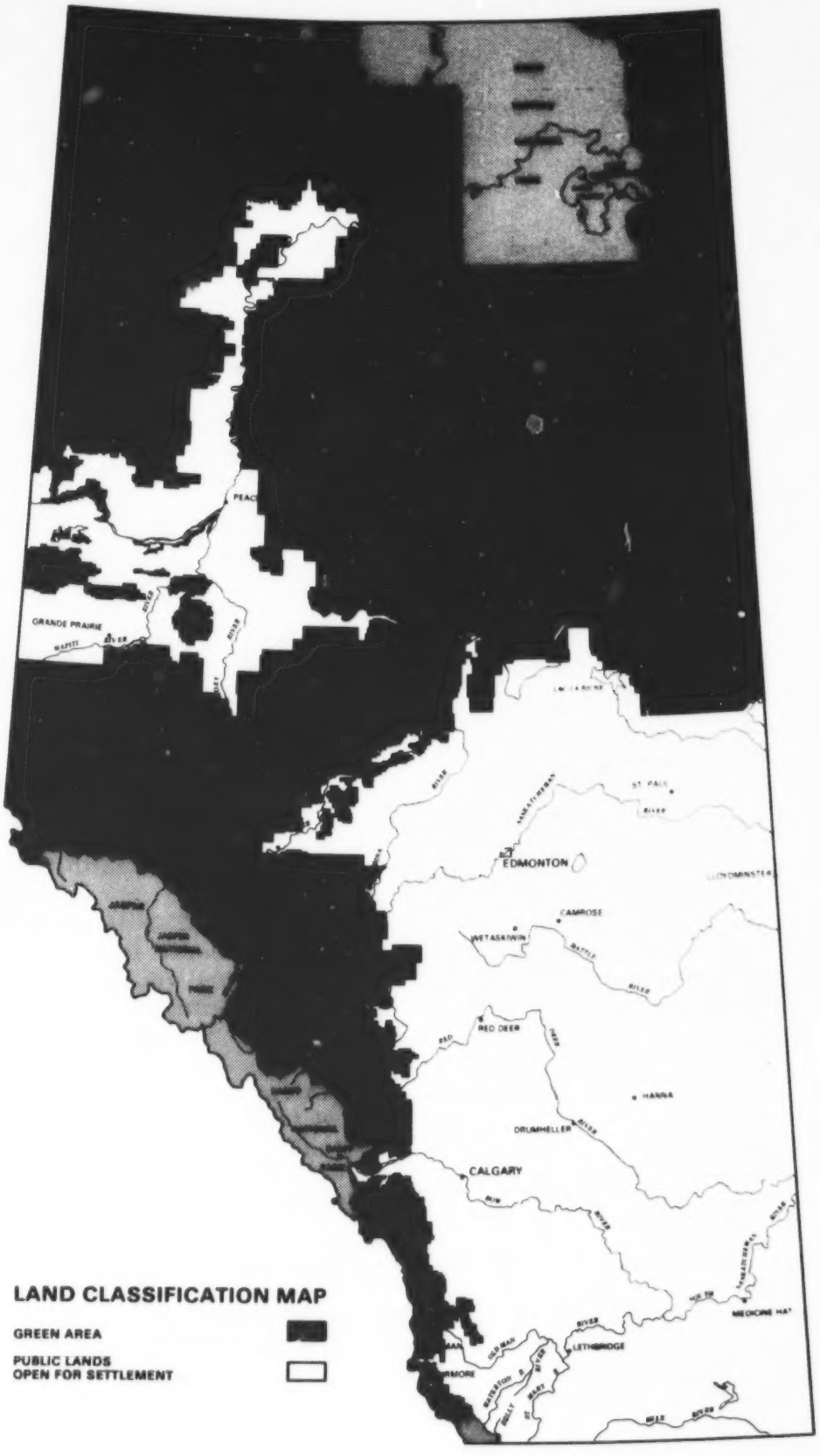
For the purpose of this handbook, the Green Area is divided into two broad categories combining low sensitive and low value areas by contrast with high sensitive and high value areas (see glossary of terms). It is recommended that a close liaison be maintained with regional and district forest service offices to determine if an industrial project is to be located in any of these sensitive or value-rate areas.

Since the Green Area consists of numerous ecological regions with a large diversification in climate, topography, vegetation, wildlife and soils it becomes necessary for operating conditions to be applied to all surface disturbance applications on a site specific basis.

Legislation and regulations referred to in this handbook may be obtained from Alberta Public Affairs Bureau, Publication Services.

All figures in this handbook are in metric. A Metric/Imperial Table is included on page 50.

All reference to "director" in this handbook means "assistant deputy minister" of the AFS where legislation is mentioned.


LAND CLASSIFICATION MAP
GREEN AREA
PUBLIC LANDS
OPEN FOR SETTLEMENT
GRANDE PRAIRIE
EDMONTON
CAMROSE
WETASKIWIN
RED DEER
DRUMHELLER
CALGARY
MEDICINE HAT
LETHBRIDGE

PART I

EXPLORATION

An operator planning exploration should refer to those conditions described under basic requirements (see Exploration Section 2) to determine the feasibility.

Subsequently, subject to review and approval, and before beginning any operations, a responsible representative of the company involved in the project must contact both the forest headquarters and the district officers to discuss and elaborate upon proposed campsites, methods of timber and debris disposal, techniques in erosion control and other requirements.

SECTION 1
SPECIFIC OPERATING GUIDELINES

(a) GEOPHYSICAL OPERATIONS

(1) Geophysical lines may be constructed by either flare cutting or windrowing but must not exceed 8 m in width.

(2) When detours are required the geophysical line must be hand cut to a width not greater than 3 m.

(3) Unless otherwise approved by a forest officer only hand cutting is permitted on either side of a stream or river and within 45 m of a lake shore. This hand cut line facilitates surveying and cable lay out.

(4) The cutting of new lines must terminate 1 km from the boundary of National Parks. However, hand cutting is allowed within this buffer zone to a distance of 90 m of the park boundary. On existing lines or in areas requiring no clearing a buffer strip of 90 m is to be retained.

(b) SAND, GRAVEL, CLAY AND MARL OPERATIONS

(1) This control guideline applies only to high value and/or highly sensitive areas. The locations of new trail construction, trenches, adits and drillsites must be approved by a forest officer before surface disturbance and should be identified on the ground by flagging.

(2) Access trails must not exceed 5 m in width and can be made by flare cutting or windrowing.

(3) This control applies only to high value and/or highly sensitive areas. Test pits must be constructed either by hand or backhoe.

(c) QUARTZ MINERAL OPERATIONS

(1) In preparing survey lines, campsites, drillsites and landing pads during summer

operations, trees and brush must be hand cut. Machine clearing and construction is prohibited in summer but allowed in winter.

(2) The location of all campsites must be approved by a forest officer.

(d) COAL OPERATIONS

(1) The location of new trail construction, trenches, adits and drillsites must be approved by a forest officer before any surface disturbance and subsequently identified by flagging on the ground. This control applies only to high value and/or highly sensitive areas.

(2) This control applies only to high value and/or highly sensitive areas. Only a program supported by helicopter will be considered in areas where slopes are steeper than 27 degrees or a slope of 2:1 (a rise of one metre over a distance of two metres).

(3) Adits must not be located on slopes exceeding 27 degrees in high value and/or highly sensitive areas.

(4) Adit landings must not exceed 6 m by 12 m unless otherwise approved by a forest officer.

(5) Trenches or test pits must be constructed by hand or backhoe and must not be located on slopes exceeding 20 degrees in high value and/or highly sensitive areas.

(6) Surplus coal material at adit sites must be buried where there is no soil erosion and where an adequate cover of soil material can be replaced on the surface.

(7) All surface disturbances including trails, drillsites, adits and trenches must be landscaped to their original contour. Surface strippings and available soil material must be replaced on the surface in reverse order of excavation, and revegetated according to reclamation guidelines.

(8) Adits must be sealed upon abandonment in accordance with Energy Resources Conservation Board (ERCB) regulations to prevent groundwater discharge. They must be recapped with soil material and revegetated according to reclamation guidelines for soil stabilization.

(e) CORE HOLE OPERATIONS

(1) Drillsites including the adjacent right-of-way must not exceed 30 m x 30 m in dimension unless otherwise authorized by a forest officer.

(2) Before a drilling rig is moved from a drillsite a tag indicating the company name and drill hole location must be placed in close proximity to the hole, however in no case should it be more than 10 m from the drill hole. All drill holes are to be properly plugged.

(3) Access trails should not

exceed a width of 10 m and must be constructed with a minimum of surface disturbance.

SECTION 2
BASIC REQUIREMENTS

These basic requirements are to be considered when conducting an exploration project and any failure to comply can result in costly follow-up reclamation work. These basics should be incorporated with those stipulated for each type of exploration work under specific operating guidelines.

(1) The topsoil should remain undisturbed by bulldozer blades when possible and only minimal reclearing of existing lines is authorized.
(2) Work may be suspended in the event of adverse weather conditions on any exploration activity until field conditions improve allowing work to resume.
(3) In high value and/or highly sensitive areas an incinerator may be required at campsites for disposal of garbage and waste materials incidental to exploration.
(4) All ribbon, other flagging and miscellaneous materials used along exploration lines must be gathered and properly disposed of as directed by a forest officer.
(5) At a stream approach only one crossing can be made at the intersection of a trail and any stream. The exploration line must avoid direct approach to streams with construction of cross ditches that divert water from natural drainage (illus. 1).

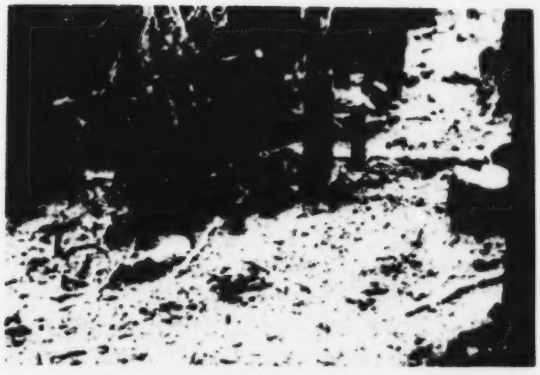
1. *PROPER STREAM APPROACH. Note these illustrated methods: (1) diversion ditches along line. (2) immediate entry to stream at 90-degree angle. (3) material from cut bulldozed away from watercourse at crossing. (4) only hand cutting allowed if seismic work done in protective zone and stumps cut flush to ground allowing vehicles into area.*

- No exploration trail is to be made closer than 45 m from the banks of any watercourse except for crossings.
- Water cannot be diverted or altered at any stream or river crossing and no soil or overburden material can be deposited or allowed to enter the watercourse.
- Disposing of debris, soil or deleterious material in any stream, river or lake is strictly prohibited.
- Watercourse crossings

are to be constructed of snow and ice whenever possible during winter and removed before spring break up.

(6) No more than a single detour shall be constructed to gain access up or down any slope or into any watercourse.

(7) In terrain where gradients are severe enough to warrant a detour for vehicular movement (illus. 2) any portion of a new line approved as a hand cut only, must not exceed 3 m in width.



2. HAND CUT SEISMIC LINE

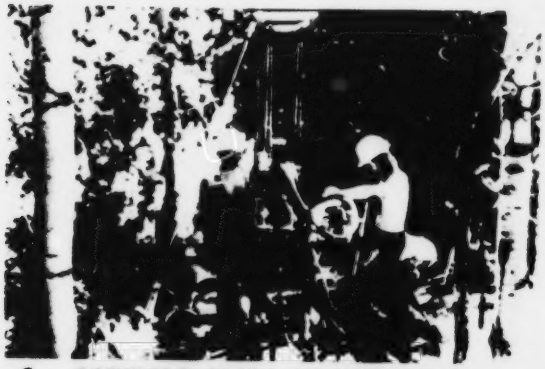
(8) When approaching an all-weather road (illus. 3 and 4) the bulldozer line cut should be constructed at an appropriate angle eliminating continuous sight down the line. Only hand cutting is permitted within 30 m of the road right-of-way edge to facilitate surveying and cable layout.

3. BUFFERING AT SEISMIC LINE INTERSECTION.

4. BUFFER ZONE. Vegetation has been retained between the all-weather road and end of bulldozer line with curved access. This is provided to eliminate continuous sight down the line from the road vantage point for wildlife and esthetic purposes.

(9) In high value and/or sensitive areas exploration may be restricted to use of portable equipment for exploration assisted by helicopter (illus. 5 and 6).

5. *BASKET CONTAINING PORTABLE SEISMIC EQUIPMENT. Equipment has been lowered from helicopter onto hand cut exploration line.*



6. *PORTABLE DRILL IN OPERATION.*

SECTION 3
TIMBER AND DEBRIS DISPOSAL

There is a significant amount of timber lost annually throughout the province due to exploration activity. With timber being an important renewable resource it is imperative precautions be taken to minimize this loss. The method incurring the least damage should be the first consideration when undertaking an exploration project with salvaging as a second concern. Clean-up operations should begin immediately following completion of the program.

All timber and debris disposal and accompanying reclamation work is to be carried out on exploration lines and access trails in accordance with the Timber Management Regulations and the Forest and Prairie Protection Regulations, Part II, along with any additional conditions stipulated at the discretion of the minister.

TIMBER SALVAGE

Requirements for timber salvage are provided under regulations governing timber management which state the following:

Section 146. A person clearing land for industrial use shall take all necessary precautions to minimize soil erosion and to avoid pollution of waters and waterways and shall keep records of all timber produced, sold and transported.

Section 147. The Minister, in his discretion, may relieve an industrial operator from salvaging timber.

Section 148. Where in that part of the Green Area of Alberta lying south of an imaginary line described in Appendix "A" of The Forest and Prairie Protection Regulations, Part II there are 25 or more merchantable and green coniferous trees exceeding 15 m in height on any hectare of land about to be cleared such trees shall be cut, looped of roots, branches and

6 m tops and shall be decked separately from all other trees and debris on clear land.

Section 149. In the event that a large number of trees are to be decked and no natural clearing is available in the area, the operator may clear 2000 m^2 of deciduous or unmerchantable coniferous timber within each section of land for that purpose.

Section 150. An industrial operator shall, within 60 days of clearing land, remove therefrom the decked timber and put it to some beneficial use or dispose of it by sale or gift.

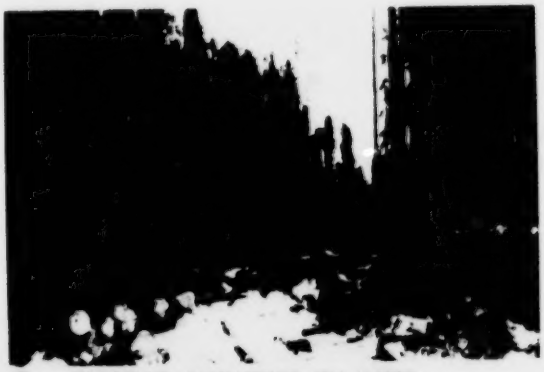
Section 151. Decked timber left for a period exceeding 60 days on the site of an industrial clearing is forfeited to the Minister.

Section 152. At the request of the Minister, a timber operator in the vicinity of decked timber forfeited to the Minister shall salvage the timber within the time allowed.

Section 153. (1) Where the holder of a forest management agreement or a timber quota neglects or refuses a request from the Minister to salvage timber in a management unit in which he has a forest management agreement or timber quota, the volume of unsalvaged timber may be charged as production against the timber quota or forest management agreement.

(2) The holder of a commercial timber permit shall salvage decked timber located in the general vicinity of his operations when he is requested to do so by the Minister.

The operator shall salvage all merchantable, coniferous timber as directed by the forest superintendent who must be contacted before clearing (illus. 7).



7. SALVAGE ADJACENT TO LINE.

In certain cases these salvage requirements may be waived, but only upon written request and subsequent written authorization.

TIMBER DISPOSAL

In circumstances where timber salvage has been waived, disposal may be accomplished in various ways. Disposal is required mainly to reduce fire hazard. Where recreational development exists or potential is proven such disposal may be necessary for aesthetic reasons. Disposal in either case is to be conducted in compliance with the Forest and Prairie Protection Regulations Part II. The applicable regulations for geophysical exploration are as follows:

Section 15. Where any land is

cleared for geophysical exploration the person in charge of operations shall dispose of the debris resulting from the land clearing in the manner prescribed unless some other method is approved by the Director.

Section 16. (1) This section shall apply to all lands in that part of the forest protection area lying north of a line described in Appendix A of these regulations excepting thereout:

(a) all lands within 90 m of the centre line of any all-weather road;

(b) all lands within 1 km of the high-water mark of lakes and stream having recreational potential as may be specified by the Director;

(c) any other particular parcel of land in respect of which the Director specifically exempts;

(d) all lands in respect of which a timber disposition is in effect.

(2) Every road and trail used or crossed in the process of geophysical exploration shall be left in substantially the same condition as it was prior to such usage or crossing.

(3) No disturbed tree shall be left in a leaning position.

(4) Every geophysical operator cutting forest growth within the area described in this section shall pay to the Minister on demand a forest protection levy at the rate of $15.55/km of line cut.

Section 17.

(1) The provisions of this section apply to geophysical exploration operations within any part of the forest protection area lying south of a line described in Appendix A and areas excepted in section 16.

(2) The partial disposal of debris that results when trees are severed from the ground is permitted and such of the following methods of disposal as may be necessary shall be used;

(a) all limbs of felled trees shall be severed from the bole and scattered in such a manner that the debris will lie flat on the ground;

(b) when stands of trees 10 cm and less in diameter at breast height are severed from the ground and can be made to lie flat on the ground by crushing with heavy machinery the removal of limbs from trees is not required but additional clearing to accommodate crushing shall not be permitted;

(c) windrowing of debris is permitted but (i) each windrow shall be no more than 60 m in length and shall be separated from adjacent windrows by a minimum clearing of 8 m, (ii) windrows shall not be piled against standing forest cover, (iii) addi-

tional clearing of lines to accommodate windrows shall not be permitted;

(d) if any of the above methods are not pratical in a particular case any alternative method which he considers appropriate may be approved by the forest superintendent.

(3) No disturbed tree shall be left in a leaning position.

(4) Every road or trail used or crossed in the process of geophysical exploration shall be left in substantially the same condition as it was prior to such usage or crossing.

(5) The partial disposal of debris must be accomplished not later than 18 months after line construction.

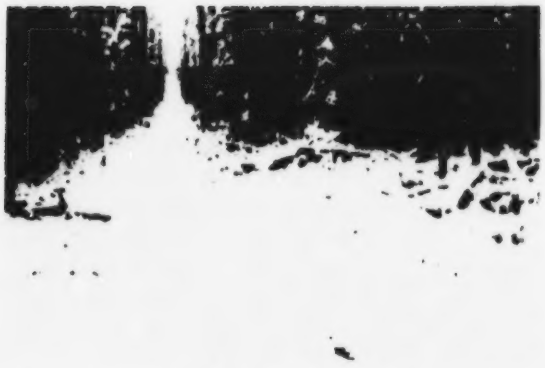
Section 18. The partial debris methods set out in section 17 also apply in the forest protection area to survey lines, fence lines, winter use roads, airstrips constructed for winter use that are not accessible by road during the fire season and pipeline rights-of-way of less than 8 m.

If salvage is not required the line may be constructed by flare cutting, (illus. 8) or it may be windrowed to one side in highly sensitive areas when approved by the department (illus. 9) so the debris can be spread back over the disturbed surface and walked down by a bull dozer to act as an erosion control measure.

8. FLARE CUTTING.

9. DEBRIS BULLDOZED TO ONE SIDE.

An acceptable method for partial brush disposal (illus. 10) is by cutting the tree trunk close as possible to the root system (less than 30 cm) and bucking the trunk into lengths short enough to enable the boles to lie flat. The limbs are lopped.



10. PARTIAL BRUSH DISPOSAL.

Scattering debris back on the line and compacting it is another way of partial disposal on right-of-way. Refer to blockage policy (page 17). This creates effective erosion control by retarding water flow. Microsites are also created assisting plant germination and growth (illus. 11).

11. DEBRIS SCATTERED BACK ON RIGHT-OF-WAY.

SECTION 4
EROSION CONTROL

Erosion is the removal of soil material by running water, wind or gravity.

Erosion is caused by several factors. The primary concern here is the effects of water. The chief factors governing the rate of water erosion are precipitation, topography, and vegetation. Cut and fill situations can be altered to minimize erosive forces by careful attention to layout and construction planning of such things as site location, gradients, size of clearing. Precautionary measures such as cross-ditching and establishing a vegetative cover on all slopes immediately following the completion of a program may be required to prevent soil erosion and sedimentation. Control of pollution and erosion is pursuant to the Forest and Prairie Protection Regulations Part II which states:

Section 21.

(1) Where any operations are conducted in a forest, the person conducting the operations shall

(a) remove or remedy any interference with the normal drainage of water from land, where such interference has been caused by the operation,

(b) remove, without causing channel damage, any obstruction to the natural flow of water in any stream channel or watercourse, whether temporary or permanent, where the obstruction has been caused by the operations,

(c) prevent soil erosion, sedimentation of

streams or reduction in watershed capacity caused by the removal of trees, shrubs and other vegetation, disturbance of land surface, or any other cause resulting from the operations and a growth of vegetation sufficient to prevent accelerated erosion shall be re-established and maintained on all bare soil areas unless otherwise approved by the Director.

(d) in lieu of carrying out soil erosion control and re-establishment of vegetation on geophysical lines in designated areas in the Province, at the Minister's option upon demand, pay to the Minister the sum of $18.65/km of geophysical line cut or used in the course of that person's operations.

(2) No person shall while in a forest, cause contamination or pollution of any land, water system, river or stream, or in any way accumulate waste material which may, during spring run-off or flood periods, be carried into any water system, lake, river or stream.

(3) In carrying out the provisions of this section, every person shall comply with any directions given by an officer in regard thereto.

CROSS DITCHING

There are several methods used in controlling erosion. The purpose of cross ditching is to intercept and divert surface runoff from lines of natural drainage. Exploration lines should be constructed to provide drainage to the downhill side of existing terrain where the topography makes erosion control necessary.

Providing a convenient slope to the downhill side of the trail capable of diverting water from the trail should achieve the desired result. The removal of the berm on the downhill side at intervals will ensure adequate drainage.

Some cross ditching may be added to ensure adequate water dispersal. Hand tools or a corner of a bulldozer blade can be used to make these small diversion channels coincide with openings in the berm (illus. 12).

12. CROSS DITCHING WITH A BULLDOZER.

On exploration lines where mechanical erosion controls are applied a satisfactory vegetative cover is required because if a

vegetative cover is not established the ditching will silt up and become ineffective.

INTERVALS FOR OPENINGS IN BERM AND CROSS TRENCHES

Soil Condition

Slope Gradient	Erodible (Fine Textured soils such as silts and clays)	Normal (Medium Textured such as loams)	Rocky (Coarse Textured such as sands and gravel)
Gentle (under 5%)	45 m	60 m	No erosion likely
Moderate (5%-10%)	30 m	45 m	60 m
Steep (over 10%)	15 m	30 m	45 m

NOTE:
1. ditch must be constructed to allow vehicle cross-over without destroying ditch.
2. water must be diverted into heavy vegetation.
3. vegetative cover must be established immediately on right-of-way.

14. ONE WAY CROSS DITCHING. Construction of cross ditches on exploration line when drainage is in one direction only.

The effectiveness of cross ditches and a vegetative cover are shown in illustrations 13 through 25.

13. CROSS DITCHING. The line in the centre has been cross ditched and seeded, giving a limited runoff in comparison to the line approaching from the left with no erosion control measures.

15. TWO WAY CROSS DITCHING. Construction of cross ditches on exploration line when two-way drainage occurs.

16. *CROSS DITCHING ON A DEEP CUT LINE.*

18. *OBSTRUCTIONS TO RETARD RUNOFF. In some cases obstructions should be utilized to retard the downward flow of sediment with water runoff.*

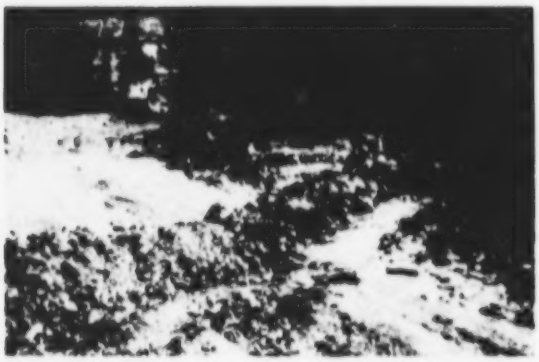
17. *CROSS DITCHING AND DITCH BLOCKING ON DEEP CUT LINES. Construction of cross ditching and ditch blocking at intervals along deeply-cut exploration lines can divert water from natural drainage to areas of heavy vegetation on both sides of the line creating effective erosion control.*

19. *BERM REMOVAL. For effective erosion control the berm should be removed at intervals when the exploration line is on a sidehill. This allows water to be diverted off the right-of-way into nearby vegetative cover.*

20. *CROSS DITCH CONSTRUCTION. Angle and tilt the bulldozer blade for construction of a cross ditch.*

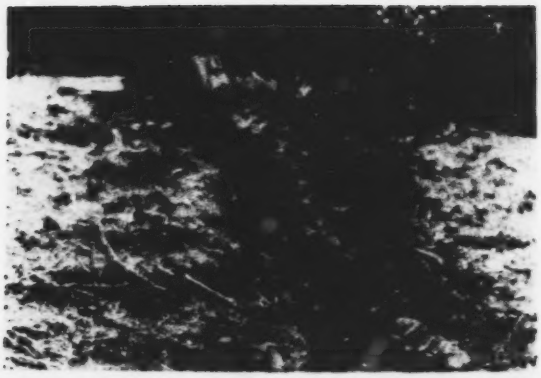
22. *CROSS DITCH CONSTRUCTION. Ditch construction completed by pushing regolith material through end of ditch for proper drainage with no berm.*

21. *CROSS DITCH CONSTRUCTION. Begin constructing ditch by pushing regolith material at a 30 to 45 degree angle to the trail and at a depth of about 40 cm.*



23. *CROSS DITCH CONSTRUCTION. Advantage of this type of completed cross ditch is that the ditch is not rendered ineffective by vehicular traffic.*

24. *CROSS DITCH CONSTRUCTED BY HAND. Notice the log laid and staked at lower side to protect ditch from vehicle traffic.*



25. *CROSS DITCH CONSTRUCTED BY HAND. Notice (a) log placed and staked at 30 to 45 degree angle to line (b) 15 to 20 cm or deeper trench dug on uphill side with overburden material placed on low side and on top of log (c) end of ditch opened to allow free drainage.*

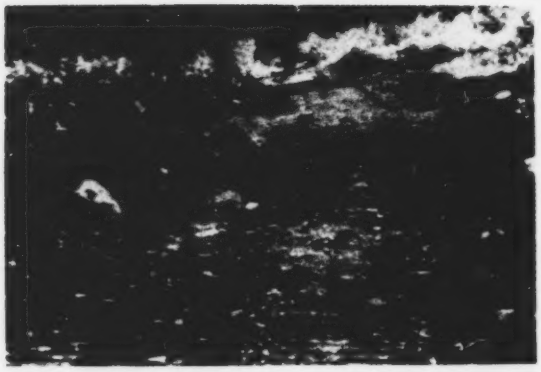
REVEGETATION

The prime purpose of revegetation, particularly seeding to grass, is to establish a root system as dense as possible as a defence against erosion. At the same time this limits above ground growth to decrease possible fire hazards.

The selection of various types of vegetation should be made on the basis of the particular soil involved, taking into consideration the factors affecting erosion where revegetation is required. Sites differ and evaluation of the best vegetative and fertilizer mixture can be determined using these simple guidelines:

(1) observe past successes on similar sites in the area.
(2) obtain technical or professional advise from persons with experience in the area or on similar sites.
(3) obtain a soil analysis to determine suitable application of fertilizer and the vegetation species mixture to seed.

Microsites created by bulldozer cleats should be used to assist in establishing a vegetative cover providing moisture retention and cover for plant germination and growth (illus. 26).



26. *BULLDOZER TRACKS CREATE MICRO-SITES FOR VEGETATIVE ESTABLISHMENT. Seed and fertilizer mixtures known to have been successful are outlined in Appendix B. The mixtures are listed for general reference only.*

SECTION 5
RECLAMATION FOR ABANDONMENT

Varying degrees and combinations of reclamation methods may be required by an operator, depending upon conditions encountered on exploration sites or rights-of-way. The recommended approaches in preparation for abandonment include recontouring of land, grass seeding or revegetation, and the final spreading of debris.

It is vitally important to private companies that requirements be set out during the planning stages of a proposed exploration project. The cost of neglected reclamation can mount, pushing the price of exploration well beyond budget allocations. Maintaining a strict co-ordination of final abandonment plans with initial preparation is a simple solution.

The objectives of reclamation are:

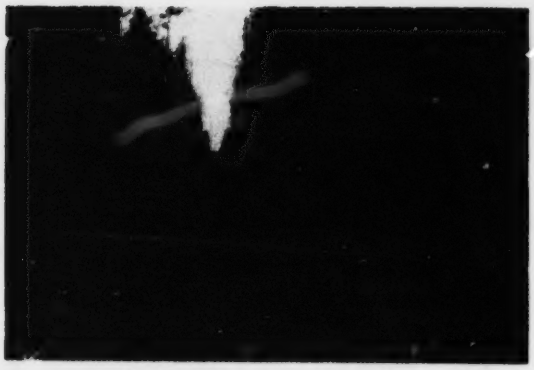
(1) To establish a self-sustaining vegetative cover to stabilize the disturbed soil.
(2) To reclaim the land to a forest environment which is consistent to the region in land forms, vegetative patterns and hydrology.
(3) To reconstitute the land to a productivity at least comparable to the original undisturbed condition.

RECONTOURING

The process of recontouring is most likely to be required in high value and/or highly sensitive areas. It can best be depicted by illustrations 27 through 32.

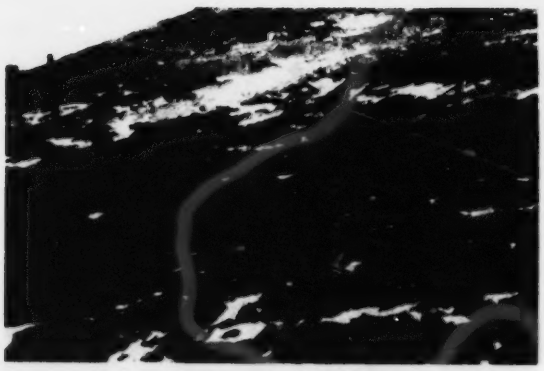
27. *RECONTOURING. Recontouring of an exploration trail using a bulldozer and Gradall to replace sidecast overburden.*

28. RECONTOURING. Reclaiming an access trail to original contour.



30. RECONTOURED TO ORIGINAL CONTOUR AND REVEGETATED.

29. RECONTOURED EXPLORATION LINE IN HIGH VALUE AREA.



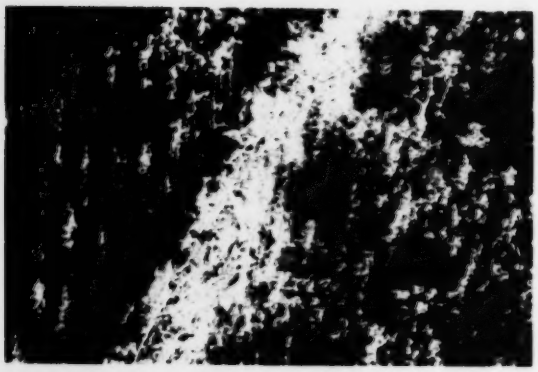
31. LANDSCAPED TO ORIGINAL CONTOUR. Overburden material replaced and landscaped to original contour and disturbed area seeded.

32. REGENERATED DISTURBED SITE ONE YEAR FOLLOWING SEEDING.

SPREADING DEBRIS

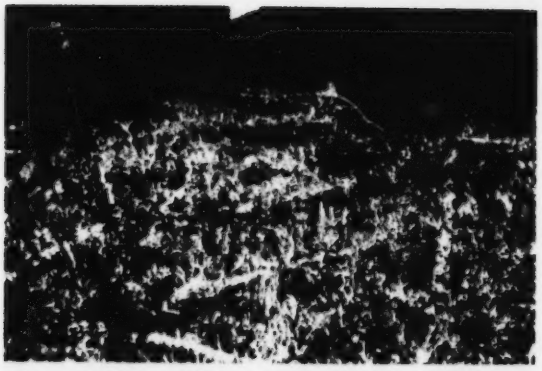
Slash and debris can be used to control erosion by retarding runoff water and by reducing the impact of rainfall or wind. Properly dispersed slash can also assist in revegetation by providing microsites for seed germination and plant growth (illus. 33 through 35). Final decomposition can release plant nutrients, improving its reclamation capability.

An ENR policy directive with regard to spreading debris back on any access states: "Reclamation must not be designed specifically to impede public use of access trails or lines by placing physical barriers on them or through modification of recognized reclamation techniques. In cases where normal reclamation work results in a line blockage it may prove acceptable if shown to be absolutely necessary for erosion control. Where seismic lines or trails are known to be heavily used by the general public, blockages should be avoided through the choice of acceptable reclamation techniques. If this is not possible steps should be taken in consultation with the director of forest land use to place announcements in the news media explaining the problem and advising of possible alternate routes".



33. SLASH LEFT ON SLOPE. This helps retard surface runoff and provide microsites for plant germination and growth.

34. DEBRIS SCATTERED OVER RIGHT-OF-WAY. Debris was compacted by a bulldozer and the disturbed area was seeded to grass. Debris should be broken up by walking over it with a bulldozer to reduce fire hazard.



35. *SAME SITE ONE YEAR LATER. This shows satisfactory growth of vegetation by artificial seeding and natural regeneration to an acceptable level.*

PART 2

DEVELOPMENT

Many of the conditional procedures relating to the development of resources under an industrial application are interwoven with the conditions regulating the exploration process. Development planning should not be advanced without further reference to the basic requirements (see Development: Section 2).

The five sections detailed here represent follow-through stages similar to the initial phases of exploration.

SECTION 1
SPECIFIC OPERATING GUIDELINES

(a) LICENCE OF OCCUPATION
(Access and Haulage Roads)

(1) Proper drainage shall be incorporated into road construction on the cut and fill slopes or in ditches to minimize erosion on the road surface.

(2) Special erosion control measures may be required on cuts or fills greater than 6 m to reduce bank erosion, including such measures as contour trenches or terracing.

(3) All roads must be maintained in such a manner as to allow proper drainage and to prevent erosion.

(4) Roads not used will either be put to bed in a manner which will minimize erosion or they shall be maintained for drainage to prevent erosion.

(b) MINERAL SURFACE LEASES
(Wellsites)

(1) A gas or oil-fired incinerator may be required at the wellsite and/or campsite for garbage disposal.

(2) Sump locations must be approved by a forest officer.

(3) Sumps must be located in stable, impermeable soil on the uphill side of a leasehold.

(4) If circulating tanks are required for sump fluids, the fluids must be hauled to a safe disposal site approved by a forest officer. Written authority must be received.

(5) Sumps constructed in porous soil material must be sealed by an acceptable liner or other approved material, to prevent leakage.

(6) Well clean-out fluids must be isolated from the main sump on completion of well drilling operations. A separate sump with a minimum 320 m^3 capacity must be constructed or the flare pit may be made sufficiently deep.

(7) Sump fluids must be disposed of in accordance with the ERCB Interim Directive No. ID-OG-75-2 (Appendix

C).

(c) PIPELINES

(1) When excavating a trench for the installation of a pipeline in the bed of a primary or secondary stream or river the excavated material must be removed from the watercourse before backfilling.

(2) The pipeline must have its location properly marked after burying.

(d) TRANSMISSION LINES

(1) Variable width clearing and occasional deflections (to reduce line of sight) should be used through scenic forest or recreational areas. This applies to high value areas only.

(e) SAND, GRAVEL, CLAY AND MARL QUARRY

(1) Gravel must not be removed from the outer bend of a watercourse.

(2) Gravel should not be removed near high cut banks which appear unstable and where slippage may occur.

(3) Gravel should not be removed within 90 m of any structure, such as a wellsite or roadway.

(4) When a gravel pit is cancelled before the gravel supply is exhausted the operator must reclaim the excavated area but the open face of the pit may remain the same allowing for future extraction of all useable gravel.

SECTION 2
BASIC REQUIREMENTS FOR DEVELOPMENT

When planning for development operations on forest land, the same basic caution as planning an exploration project should be noted. Failure to comply with requirements can result in costly reclamation work being needed. The following basic requirements should be incorporated with the conditions stipulated for each type of development described under specific operating guidelines:

(1) An operator must establish contact with the regional forest office before construction and maintain continuous liaison with the forest officer. Further information can be acquired directly from the superintendent of the forest.

(2) Surface disturbances on certain lands within the Green Area may be the responsibility of the Public Lands Division of Alberta Energy and Natural Resources. In these cases, continuous liaison must be maintained with the land inspector.

(3) In high value and/or highly sensitive areas all locations must be identified with appropriate ground flagging before any surface disturbances are started. These locations must be approved before beginning operations.

(4) A copy of the letter of authority must be in the

possession of the person in charge of the development operation on site (in high value and/or highly sensitive areas) during all activity.

(5) No stream diversion is to be made without approval by the appropriate government agency.

(6) Where timber has to be removed from the top of a back slope approval must first be acquired from the forest officer.

(7) All reclamation of disturbed lands must meet forest service requirements and conform with the government's reclamation guidelines.

(8) Wherever possible a right-of-way should be set within a common corridor with (illus. 36) existing clearing and access routes utilized at every opportunity. This minimizes the amount of damage to new timber.

36. COMMON CORRIDOR. A pipeline and transmission lines in a common corridor resulting in a narrower right-of-way and less surface disturbance.

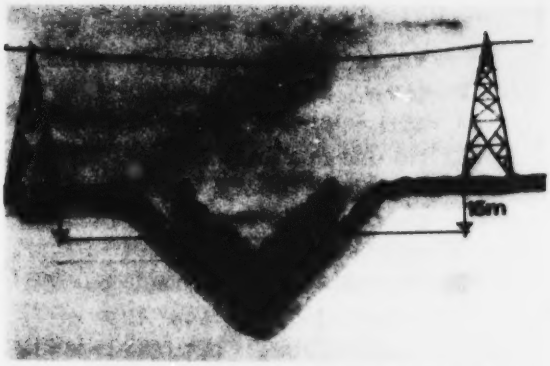
(9) All disturbed areas must be kept free of noxious weeds and their spread prevented. Details are stipulated in Section 60 of the Public Lands Act.

BUFFER ZONE REQUIREMENTS

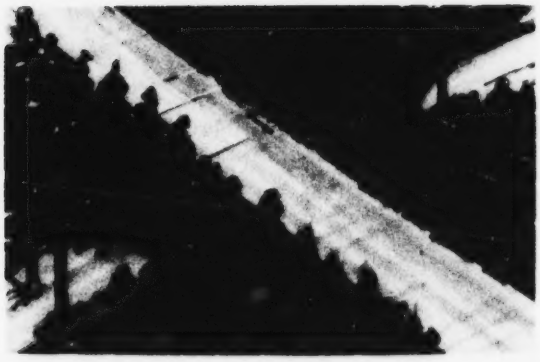
An undisturbed buffer strip of a minimum 90 m should always be retained between an operation (such as a wellsite location) and an access road right-of-way, lakes, rivers or streams (illus. 37 through 41).

37. BUFFER BETWEEN A WELLSITE AND A LAKE.

38. *BUFFER OF WINDFIRM TREES BETWEEN BORROW PIT AND RIGHT-OF-WAY FOR ROADS. Note access road to pit is constructed at an angle to reduce sight distance and to screen the pit from the main road.*



40. *RIGHT-OF-WAY CLEARING RESTRICTION WHEN CROSSING A VALLEY. No right-of-way clearing should be carried out 15 m or more below line of tower bases when a transmission line crosses a valley.*



39. *SCREENING IN HIGH ESTHETIC AREAS. Where power lines go through forest or timbered areas of high esthetic value, long spans should be used at major highway crossings to provide a screen of natural growth.*

41. *VARIABLE WIDTH RIGHT-OF-WAY TO ACCOMMODATE A SLOPE. For example, on a 45 degree slope the downside clearing should be 15 m below the line of lower base.*

POLLUTION PREVENTION

To prevent seepage which can cause damage, an impermeable berm, dike or diversion ditch must be constructed around the low side of a leasehold to retain surface water and other wellsite fluids. This may be accomplished by sloping the ground toward the centre and uphill side of the lease (illus. 42 and 43).

42. *PROPERLY CONSTRUCTED DIKE ON THE LOW SIDE OF A LEASE. This will retain contaminated water for treatment.*

43. *DIVERSIONARY DITCH AROUND THE HIGH SIDE OF A LEASE. This may have to be constructed to divert surface water around the lease.*

SECTION 3
TIMBER AND DEBRIS DISPOSAL

A significant amount of timber is destroyed through resource development. Every effort must be made to salvage merchantable coniferous timber. This timber can be salvaged to sawlog utilization standards or smaller if a reasonable market exists and provided it can be utilized within two years of felling (illus. 44 through 46). The feasibility of salvage in any situation will be assessed by the regional forester. The decision will be contingent upon terrain, access and proximity to markets.

TIMBER SALVAGE

Sections 146 to Section 153 from the Timber Management Regulations as applied to exploration also govern the development stage of operations (see page 5).

44. *PRELOGGING A RIGHT-OF-WAY.*

45. *SALVAGED MATERIAL DECKED IN AN APPROVED LOCATION. Remaining limbs are removed for suitable recovery and removal.*

46. *PRELOGGED RIGHT-OF-WAY BEFORE CONSTRUCTION.*

DEBRIS DISPOSAL

Besides the regulations on exploration projects listed earlier the following conditions also apply equally, where applicable, to both exploration and development. When disposal by burning is required, follow Sections 17 and 18 of the Forest and Prairie Protection Act which details the requirement and issuance of a provincial burning permit.

(1) Under resource development, total disposal of debris by burning at a safe time is required on land cleared for the following operations:
   (a) pipelines having an 8 m or more right-of-way
   (b) oil and gas wellsites and tank storage sites
   (c) right-of-way for roads other than roads for winter use
   (d) power lines and telephone lines
   (e) sawmill, planing mill and logging camp sites
   (f) radio and microwave sites
   (g) sand and gravel, dam, bridge, and water storage sites
   (h) projects dealing with the recovery of minerals as defined by the Mines and Minerals Act including tar sands development
   (i) airstrips other than those constructed for winter use and those not accessible by road during fire season
   (j) any building or structure
   (k) any other land use as may be prescribed by the director of AFS.

Before burning, place all debris from the areas in windrows or piles not exceeding 60 m in length and separated by 8 m firebreaks (illus. 47).

(2) Locate windrows or piles to be burned along the centre of any right-of-way no less than 30 m wide. On other cleared areas do not burn within less than 15 m from adjacent uncleared areas or standing forest.

47. DEBRIS DISPOSAL BY BURNING.

(3) Where waste material has not been totally consumed by burning, dispose of residue in the following manner with the approval of a forest officer:
   (a) on wellsites within the Green Area any residue may be compacted and buried in sump pits provided a minimum of 1 m of mineral soil covers the debris and the natural ground contours are maintained.
   (b) on roads where deep fills are required in the grade, residue may be compacted and buried providing a minimum of 1 m of mineral soil covers the residue and the natural ground contours are maintained.
   (c) the 0.5 m of compacted mineral soil and natural ground contour rule also applies to residue buried in natural openings or in clearings adjacent to rights-of-way.
   (d) tree stumps not completely burned may be scattered adjacent to and out of sight of the right-of-way clearing.

(4) The time allowed for disposal of debris regardless of any delays is one year. This is because old, dry debris raises the danger of fire and the spread of fire with the varying weather conditions. It is the responsibility of the operator handling the debris to provide sufficient standby firefighting equipment and manpower during a burn, and to provide additional equipment and manpower if deemed necessary by the forest officer. The forest superintendent is the only person with authority to approve any other method of disposal.

(5) Buried material has a tendency to settle, causing depressions. There is also the possibility of someone digging in the burial site during another operation such as pipelining. The buried material may be exposed when preparing a

development site or right-of-way for abandonment. Therefore, it is preferable to scatter unburned residue out of sight.

OTHER DISPOSAL METHODS

A slash reducing implement such as a landbreaker, hydro-axe or mechanical chipper is permitted for brush disposal provided all merchantable coniferous timber has been salvaged along the right-of-way (illus. 48 through 52).

49. TOTAL BRUSH DISPOSAL USING A MADGE ROTARY LANDBREAKER. This can be used on timber not greater than 15 cm in diameter at the stump.

48. TOTAL DISPOSAL ON A PIPELINE RIGHT-OF-WAY. All debris has been piled and burned with unburnt stumps scattered into standing timber. Top soil has been salvaged and spread on the right-of-way to assist revegetation.

50. TOTAL DISPOSAL ON A PIPELINE RIGHT-OF-WAY. Using a landbreaker makes wood fibre mulch. This is effective in erosion control and revegetation.

51. HYDRO-AXE REMOVING YOUNG GROWTH.

52. HYDRO-AXE REMOVING YOUNG GROWTH. When using hydro-axe, root systems are not disturbed, limiting erosion.

SECTION 4
EROSION CONTROL

In this section we are primarily concerned with erosion by water. Factors that affect water erosion are as follows:

(1) CLIMATE - Amount, frequency and character of rainfall, together with temperature, are the most important climatic factors influencing erosion.

(2) SOIL CHARACTERISTICS - The amount of surface runoff is influenced to a marked degree by the infiltration capacity of the soil. Surface runoff occurs only when rainfall intensity exceeds infiltration capacity.

(3) DEGREE AND LENGTH OF SLOPE - The extent and rate of water flow are proportionate to the degree of land gradient. The direction in which the slope faces is also important. Dry, south-facing hillsides bearing sparse vegetation and with low plant recovery potential are more susceptible to erosion than moist, well-vegetated, north slopes.

(4) VEGETATION - Extensive and vigorous plant cover reduces opportunities for erosion in the following ways:
   (a) Infiltration of water is favored;
   (b) root systems hold soil mechanically, hindering its removal; and
   (c) the soil surface is protected from wind.

(5) INDUSTRIAL AND AGRICULTURAL PRACTICES - Erosion is accelerated when vegetation is removed or its density reduced.

Erosion by water is classified into three categories:

(1) SHEET EROSION - The removal of soil in fairly uniform amounts from the

land surface by runoff water.

(2) RILL EROSION - More severe than sheet erosion. It creates individual streams on the land surface. The streams create or follow some mark or depression and cut rapidly into the surface. Large quantities of soil may be removed during a single storm.

(3) GULLY EROSION - Occurs when uncontrolled rills become wider V-shaped channels, broadening and deepening as they descend.

When a site or right-of-way is being prepared, it is most important that all precautions and safeguards necessary be taken to avoid the inception of soil erosion and siltation of any watercourse, and comply with directions given by a forest officer.

The Public Lands Act provides legislation for the control of erosion as does Section 21 of The Forest and Prairie Protection Regulations Part II which states:

Section 21.

(1) Where any operations are conducted in a forest, the person conducting the operations shall

(a) remove or remedy any interference with the normal drainage of water from land, where such interference has been caused by the operation,

(b) remove, without causing channel damage, any obstruction to the natural flow of water in any stream channel or watercourse, whether temporary or permanent, where the obstruction has been caused by the operations,

(c) prevent soil erosion, sedimentation of streams or reduction in watershed capacity caused by the removal of trees, shrubs and other vegetation, disturbance of land surface, or any other cause resulting from the operations and a growth of vegetation sufficient to prevent accelerated erosion shall be re-established and maintained on all bare soil areas unless otherwise approved by the Director.

(d) in lieu of carrying out soil erosion control and re-establishment of vegetation on geophysical lines in designated areas in the province, at the Minister's option upon demand, pay to the Minister the sum of $18.65/km of geophysical line cut or used in the course of that person's operations.

(2) No person shall while in a forest, cause contamination or pollution of any land, water system, river or stream, or in any way

accumulate waste material which may, during spring run-off or flood periods, be carried into any water system, lake, river or stream.

(3) In carrying out the provisions of this section, every person shall comply with any directions given by an officer in regard thereto.

STABILIZING SOIL CONDITIONS

The purpose of soil stabilization is to provide soil conditions on all slopes to favor the development of vegetation (illus. 53). On more difficult sites stabilization can be accomplished by applying mulches of brush or straw along slopes. This can be augmented by lopping and scattering brush cleared from the wellsite or road right-of-way.

53. SLOPE STABILIZATION.

REVEGETATE

At the completion of drilling, the company must revegetate the entire disturbed area to an approved grass seed mixture and ensure it is established and maintained. The area immediately surrounding a producing wellhead/flare pit can be excepted.

Some general seed and fertilizer mixtures known to have been successful are outlined in Appendix B. The mixtures outlined are listed for general reference only.

In areas with erosion problems (highly sensitive areas), such as soils with a silt or fine sand texture on steep slopes, debris may be scattered over and compacted into the disturbed soil material. A satisfactory vegetative cover must be established on the disturbed areas according to the following AFS revegetation guidelines:

(a) Regolith material (including surface strippings) most suitable for revegetation shall be salvaged and replaced, to a depth at least equal to the rooting depth of the plant species used for revegetation prior to the termination of the growing season, following backfilling and/or initial recontouring. The regolith material shall be reconstructed so that surface materials and water relationships are conducive to plant growth.

(b) Disturbed lands shall be seeded and/or planted with suitable plant species during the proper planting period or immediately following final recontouring to achieve soil stabilization by the end of two growing seasons (illus. 54).

(c) Standards for herbaceous vegetation or for herbaceous

ceous vegetation plus woody plants require at least 60 percent ground cover of live foliage in which areas with substandard ground cover neither exceed 4 m^2 in size nor total more than 10 percent of the reclaimed area. Measurements shall be made after two growing seasons to ensure initial soil stabilization, using the line transect range survey method for plant density and composition, and an ocular estimate to assess plant vigor.

54. SEEDING AND FERTILIZING CARRIED OUT PROGRESSIVELY.

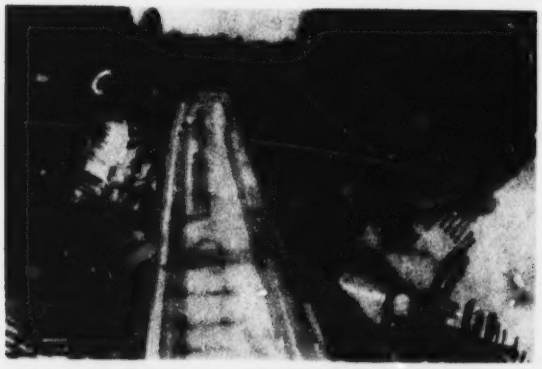
DIVERSION DITCHES AND RUNOFF OBSTRUCTIONS

The purpose of diversion ditches and runoff obstructions is to divert and slow the flow of water in ditches and along roadways.

The company must provide adequate cross and diversion drainage into undisturbed vegetation adjacent to the denuded areas, to prevent cutting and soil erosion.

Where roadway, powerline, flowline and pipeline rights-of-way run directly up and down gradients, the following construction methods should be applied to prevent erosion:

(1) IF DITCHED - diversion channels should be constructed to divert water from ditches into heavily-vegetated areas (illus. 55).
(2) IF NOT DITCHED - (e.g. pipelines, seismic lines) diversion channels should be constructed as shown on seismic line restoration methods.



55. DIVERSION CHANNELS.

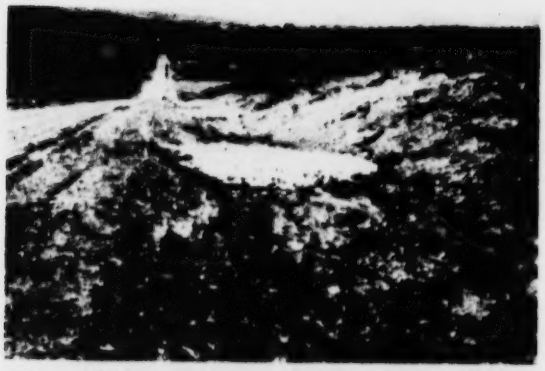
DITCH BLOCKS

Ditch blocks are used mostly to retard surface runoff and trap sediment on slopes. Spacing depends on ditch gradient, length, soil texture, precipitation and snowmelt (illus. 56 through 58).

Ditch blocks can also be used with culverts to direct runoff into a favorable vegetative cover and/or drainage off the right-of-way.

56. DITCH BLOCK USING TIMBER AND ROCKS.

58. DITCH BLOCK USING STRAW BALES. Although not as effective, straw bales may be used provided they are adequately staked, properly placed and maintained.

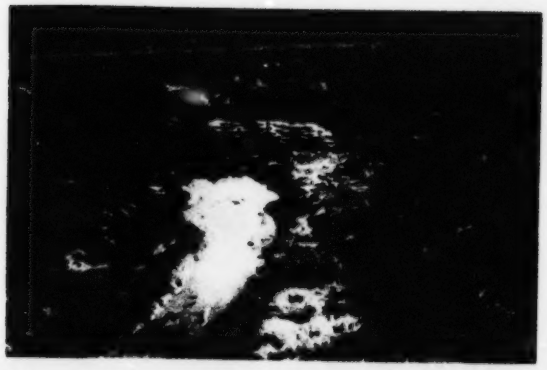


57. DITCH BLOCKS USING ROCK AND GRAVEL.

CULVERT

On watercourses identified as fish bearing, it is imperative that a proper bridge be installed and/or culverts be used but only following approval from a Fish and Wildlife Habitat Biologist.

Culvert riprap prevents scour of bank and fill, and excessive siltation during peak flows. The culvert in illustration 59 has been installed within the stream bed at a low gradient (less than 0.5%) to allow fish passage.

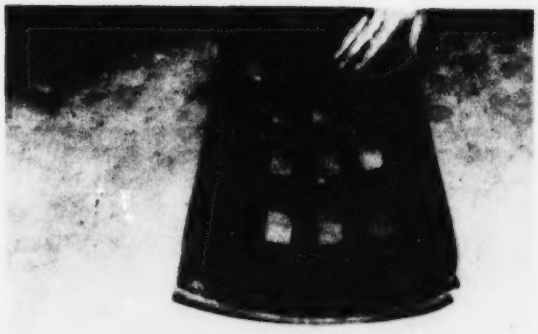


59. CULVERT PLACED WITHIN A STREAM BED AND PROPERLY RIPRAPPED.

Raised invert (waterfall at downstream end) results in barrier to fish passage (illus. 60). The culvert should have been installed with its bottom in the streambed and in line with the streambed. If this results in too steep a gradient and too high velocity for fish passage, a bridge may have to be installed to prevent whirlpools in water resulting in bank slumping. The culvert requires riprap.

60. RAISED CULVERT INVERT RESULTS IN A BARRIER FOR FISH PASSAGE.

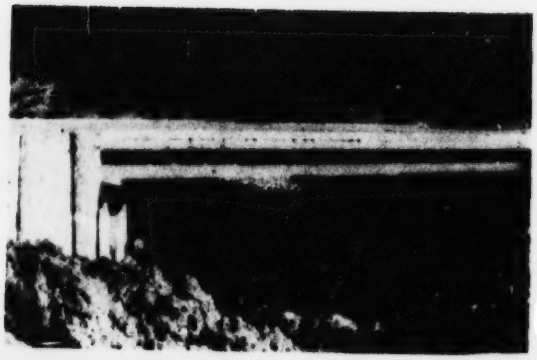
In fish bearing streams where culverts are approved, baffles may have to be installed to facilitate fish passage by reducing stream velocity, increasing the roughness coefficient and providing resting places for fish (illus. 61). Fish passage depends on the swimming ability of the fish at the time of migration, water velocity, culvert gradient, and length and height of invert.



61. CULVERT BAFFLES

BRIDGES

A properly-constructed bridge is required on all secondary and larger watercourse crossings; that is, streams having a gradient which may transport water throughout the year and has definite bank and channel development which may be suitable for fish and/or aquatic insect populations (illus. 62). Any alterations to stream status must be authorized in writing by the Aquatic Habitat Protection Section, Fish and Wildlife Division, Edmonton.



62. TIMBER BRIDGE

SECTION 5
RECLAMATION FOR ABANDONMENT

The AFS has developed site specific reclamation criteria, some of which have formed an integral part of the government's reclamation guidelines under the auspices of Alberta Environment pursuant to the Land Surface Conservation and Reclamation Act. "Guidelines for the Reclamation of Land in Alberta" dated December, 1977 were developed for all surface disturbances. Discretion must be used in applying these guidelines to site specific minor disturbances. Consultation with AFS field staff is recommended.

Reclamation for major disturbances on forest land may require the submission and approval of annual, periodic and long-range reclamation and operating plans.

Reclamation of disturbed forest lands must be conducted in an approved manner including recontouring to an acceptable land form and revegetation to achieve soil stabilization and the desired end use. The reclaimed landscape may, and in most cases should, include a variety of uses where appropriate, such as commercial timber production, habitat for terrestrial and aquatic wildlife and various kinds of recreational activities.

AFS reclamation objectives are:

(1) To establish a self-sustaining vegetative cover which stabilizes the soil;

(2) To reclaim the land to a forest environment which is consistent to the region with respect to land forms, vegetative pattern and hydrology; and

(3) To reclaim the land to a productivity at least comparable to the undisturbed condition.

In high value or highly sensitive areas, varying degrees of reclamation work may be required on sites or rights-of-way for abandonment purposes.

It is important that abandonment requirements be considered when planning a program. This will ensure there is proper coordination between the preparation of a site or right-of-way and the final reclamation.

There are several methods used when reclaiming sites and rights-of-way. The following have been used successfully:

(1) RECONTOURING

The right-of-way in illustration 63 is being landscaped to an acceptable land form by replacing overburden material back in the cut. Soil material and surface strippings were replaced on the recontoured

surface strippings were replaced on the recontoured surface to assist in revegetation and the disturbed areas seeded using an acceptable grass mixture.

Roads with cuts and fills must be abandoned by removing culverts and other drainage structures, recontouring, scarifying the road surface, replacing soil material and surface strippings and seeding to acceptable plant species (illus. 64 through 66).

64. *RIGHT-OF-WAY SATISFACTORILY RECONTOURED. The drainage structures have been removed, the side ditches obliterated, and the right-of-way has been scarified and seeded to a suitable grass/legume mixture.*

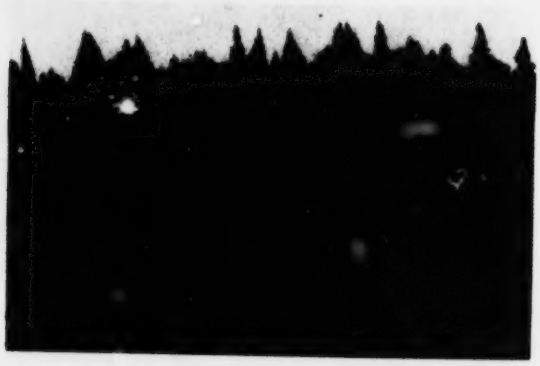
63. *LANDSCAPING OF A RIGHT-OF-WAY.*

65. *RIGHT-OF-WAY ONE YEAR FOLLOWING SEEDING. A satisfactory growth of vegetation has been established.*

66. SPREADING STOCKPILED MATERIAL. Disturbed area has been landscaped and previously stockpiled material is being spread on the surface to facilitate revegetation.

(2) GRASS SEEDING

Soil material was salvaged, replaced on the recontoured surface and the disturbed area seeded with a grass and legume mixture in illustration 67. The value of using soil material is evident by the lush plant growth one year following seeding. Another advantage of using soil material and surface stripping is evident from the numerous native plants which have re-established. Viable native seeds contained in the surface soil material aided in establishing a stable plant community.



67. SITE SUCCESSFULLY RECONTOURED AND SEEDED.

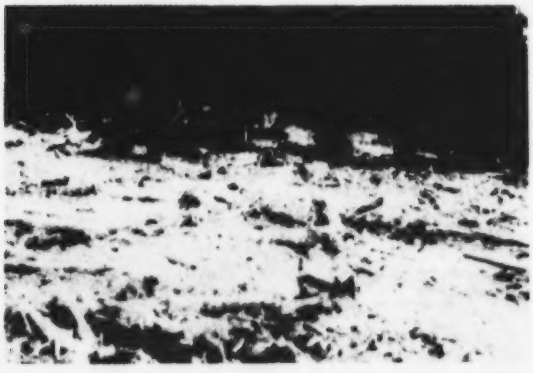
In illustration 68 the site has been satisfactorily terraced and the access right-of-way put to bed by recontouring and cross ditching. The entire area was then seeded with a grass and legume mixture to help re-establish a stable plant community (illus. 69).

68. THIS SITE HAS BEEN SATISFACTORILY PUT TO BED.

69. *SUCCESSFUL VEGETATION RE-ESTABLISHMENT. The same site on which surface stripping and soil material was spread over the landscaped surface to minimize soil erosion and assist in revegetation.*

(3) SPREADING DEBRIS

In areas where recreation or the potential for it is not of major importance, debris less than 15 cm in diameter may be scattered back on the area and compacted with heavy equipment for erosion control and revegetation purposes (illus. 70).



70. *DEBRIS SPREADING FOR EROSION CONTROL AND REVEGETATION.*

(4) TREE PLANTING

The ultimate objective in reclamation is to have the site or right-of-way returned to a forest environment which is consistent to the region (illus. 71).

ENR policy is to reforest all future disturbances such as well sites and roads located adjacent to or surrounded by young productive coniferous stands. The standards and requirements for the site will be determined by the Forest.

71. *AREA PLANTED TO NATIVE SPECIES*

GLOSSARY

Adit - approach, or in the case of mines, a horizontal entrance.

Alpine Tundra Ecological Region - land area generally located above tree line and below barren rock.

Angle of Repose - maximum angle that the inclined surface of a pile of loosely-divided material can make with the horizontal (approximately 37 degrees or 75% slope).

Aspect - direction toward which a slope faces.

Borrow Pit - sites where materials are excavated for construction or maintenance.

Buffer Strip - strip of undisturbed land, adjacent to a disturbed area, that retards the flow of runoff water, causing deposition of transported material, thereby reducing the sedimentation of receiving streams.

Check Dam - barrier constructed across a drainageway to retard stream flow and form a small, sediment basin in order to assist in sediment control.

Clean Out Fluids - acid solution, light oil or chemical solutions used to increase well production.

Compaction - closing of the pore spaces among particles of soil and rock.

Core Drilling - process by which a cylindrical sample of rock and other strata is obtained, through the use of a hollow drilling bit that cuts and retains a section of the strata penetrated.

Cross Ditch - ditch constructed horizontal to the disturbed slope for the purpose of retarding the flow, thereby reducing the sediment load.

Debris - surface stripping, slash, stumps, unmerchantable timber and brush.

Decked - placing timber in a manner to facilitate pick-up and removal.

Diversion Ditch - channel constructed across a slope to intercept surface runoff, changing the course of all or part of a stream or runoff, thereby reducing sediment problems.

Disposition - any conveyance, assurance, sale, lease, licence, permit, contract or agreement made, entered into, or issued, pursuant to the Public Lands Act.

Erosion - process of detachment and movement of soil or rock fragments by running water, wind, ice or gravity.

Gully Erosion - removal of soil by running water, causing formation of deep channels.

Hand Cutting - clearing of timber and brush utilizing hand tools, thereby leaving the root systems intact to minimize surface disturbance.

Herbaceous - non-woody vegetation.

Highly Sensitive Areas - areas of high drainage density (30 - 40 drainage courses per km^2), steep slopes, unstable soils, unstable geologic substrata and areas where adverse climatic conditions restrict plant growth, such as the Alpine Tundra, Subalpine and Canadian Shield Ecological Regions.

High Value Areas - areas rated as high value for timber, recreation, watershed, wildlife, range and archeological or historic sites.

High Water Mark - mark where the water is at its greatest elevation.

Hydroseeding - hydraulic dissemination of seed in a water medium. Mulch and fertilizer can be incorporated into the sprayed mixture.

Impermeable Material - any material that will not permit passage of a fluid through it.

Key Wildlife Habitat Area - habitat areas critical to a significant number of individuals of a species during at least part of the year, e.g. waterfowl staging and production areas, game bird dancing grounds, ungulate winter ranges.

Lop and Scatter - to remove and spread limbs, branches or tree tops, thereby reducing the fire hazard.

Low Sensitive Areas - relatively flat areas with low drainage density (4 - 8 drainage courses per km^2), stable soils, and geologic substrata, which have only slight limitations for plant growth, such as Mixedwood, Peace River Lowlands and Athabasca South ecological regions.

Low Value Areas - areas rated as low value for timber, recreation, wildlife range and archeological or historic sites.

Merchantable Timber - forests which have 25 or more green coniferous trees, exceeding 15 m in height, on any hectare of land to be cleared.

Microsites - small sites where grass seed can be established and germinated.

Prelogging - logging of timber from a site before any operation (i.e. drilling, seismic exploration) begins.

Stream Classification:

a. ephemeral draw - depression that has a gradient which may carry water during the spring or after heavy rainfall. There is little or no evidence of stream channel or bank development.

b. intermittent stream - stream which has a defined stream channel and bank development and may appear to be dry during prolonged periods of little rainfall.

c. secondary stream - stream that has a gradient which may transport water throughout the year. It has definite bank and channel development which may be suitable for fish and/or aquatic insect populations.

d. primary stream - permanent stream or small river that has sufficient gradient to transport water continuously throughout the year. There will be major stream channel and bank development within the associated valley. Fish populations may be found within this stream throughout the year.

e. rivers - these have well-defined stream channel and bank development within the valley bottom. Mass wasting of soil (slumping) may be evident on the stream banks and valley sides. Fish populations may be present throughout the year and the watercourse will usually be the main passageway for migratory fish populations of other streams.

For further information on streams, refer to Sec. 1 subsection m of the Clean Water Act.

Subalpine Ecological Region - land area generally located on the mountain uplands between the alpine tundra and foothills ecological regions characterized subalpine vegetation.

Tree Freeing - removal of hazardous trees that could fall on the powerline from the edge of the powerline right-of-way.

Terrace - sloping ground cut into a succession of benches for purposes of controlling surface runoff, minimizing soil erosion and assisting revegetation.

Total Disposal - complete removal and disposal of trees and brush by burning and/or limited burying to reduce fire hazard and improve aesthetics.

Windfirm Trees - trees with well established and undisturbed root systems.

Winter Access Road - any roadway which lacks established grade or drainage ditches for the control or erosion. It should be restricted to a maximum of 12 m in width.

APPENDIX A

THE FOREST AND PRAIRIE
PROTECTION REGULATIONS
PART II

Commencing at the intersection of the Alberta-Saskatchewan boundary with the north boundary of the south half of township 73, range 1, west of the fourth meridian; thence westerly along the said north boundary and continuing westerly along the north boundaries of the south halves of township 73, ranges 2 to 9 inclusive, west of the fourth meridian; thence southerly along the said west boundary to the south boundary of the said township 73, range 9, west of the fourth meridian; thence westerly along the said south boundary and continuing westerly along the south boundaries of township 73, ranges 10 to 26, inclusive, west of the fourth meridian to the fifth meridian; thence northerly along the fifth meridian to the north-east corner of township 75, range 1 to 22, inclusive, west of the fifth meridian, to the right bank of the Little Smoky river; thence downstream along the said right bank and continuing downstream along the right bank of the Smoky River to its intersection with the right bank of the Peace River; thence north-westerly to a point on the left bank of the Smoky River with the right bank of the Peace River; thence upstream along the said left bank of the Peace River to the Alberta-British Columbia Boundary.

APPENDIX B

SEEDING OR PLANTING

Selection of the type or types of vegetation to be used should be based on careful evaluation of factors affecting erosion.

A. Seeding
Recommended Grass Mixtures

Athabasca, Lac La Biche, Edson, Slave Lake and Whitecourt Forests
(See Map of Forests Page 43)

creeping red fescue	40%
white dutch clover	20%
climax timothy	20%
crested wheat grass	20%
total =	25 kg/ha

fertilizer as per soil analysis, or, in lieu of analysis, 16-20-0 may be used at an approximate rate of 160 kg/ha.

Bow/Crow and Rocky/ Clearwater Forests

creeping red fescue	40%
white dutch clover	12%
climax timothy	24%
Canada blue grass	24%
total =	25 kg/ha

fertilizer as per soil analysis, or, in lieu of analysis, 10-30-10 may be used at an approximate rate of 160 kg/ha.

Grande Prairie, Peace River and Footner Lake Forests

creeping red fescue	32%
crested wheat grass	32%
climax timothy	20%
alsike or white dutch clover	16%
total =	25 kg/ha

fertilizer as per soil analysis, or, in lieu of analysis, 11-48-0 may be used at an approximate rate of 160 kg/ha.

B. Planting

Trees are particularly valuable on areas where erosion is excessive and where permanent and durable protection is essential. Native species adapt best.

Where reforestation is required for commercial timber production purposes, the Forest will stipulate the number of trees per hectare.

FOOTNER
LAKE
FOOTNER LAKE
WOOD
BUFFALO
NATIONAL
PARK
FORT CHIPEWYAN
FOREST
ATHABASCA
FOREST
PEACE
RIVER
FOREST
FORT McMURRAY
SLAVE
LAKE
FOREST
PEACE RIVER
LAC
LA
BICHE
FOREST
GRANDE
PRAIRIE
FOREST
SLAVE LAKE
LAC LA BICHE
WHITECOURT
WHITECOURT
EDSON
EDSON
FOREST
FOREST
EDMONTON
LLOYDMINSTER
JASPER
NATIONAL
PARK
ROCKY
CLEARWATER
FOREST
ROCKY MOUNTAIN HOUSE
RED DEER
BANFF
NATIONAL
PARK
BOW
CALGARY
CROW
MEDICINE HAT
LETHBRIDGE
FOREST
FORESTS OF ALBERTA
FOREST BOUNDARY
FOREST HEADQUARTERS

APPENDIX C

THE PROVINCE OF ALBERTA
ENERGY RESOURCES
CONSERVATION BOARD

TO: All Operators

SUMP FLUID DISPOSAL
REQUIREMENTS

Interim Directive
No. ID-OG 75-2

Alberta Environment, Alberta Energy and Natural Resources and the Energy Resources Conservation Board have decided that sump fluid disposal standards are necessary. The decision to implement Province-wide sump fluid disposal standards arose due to concern over some of the deeper wells being drilled in the Foothills region of Alberta which result in large quantities of fluids which must be disposed of in an environmentally satisfactory manner.

The requirements outlined in this directive will be reviewed in 12 months time and may be set out in regulation form following a further period of assessment.

In accordance with the provisions of the Oil and Gas Conservation Act and the Oil and Gas Conservation Regulations, these sump fluid disposal requirements have been approved by both the Minister of the Environment and the Acting Minister of Alberta Lands and Forests.

Effective September 1, 1975, the Board requires that all operators comply with the requirements outlined in the attachment to this directive and entitled "Attachment I to Interim Directive No. ID-OG 75-2, Sump Fluid Disposal Requirements".

ISSUED at Calgary, Alberta on July 23, 1975.

ENERGY RESOURCES
CONSERVATION BOARD

D.R. Craig
Vice Chairman

NOTE: This Interim Directive is under review. A revised Directive is expected to be released in spring, 1985.

1.0 Disposal of Sump Fluids to a Subsurface Formation

Disposal of sump fluids to a subsurface formation is an acceptable procedure provided:

a. Approval is first obtained from the Energy Resources Conservation Board.
b. The subsurface formation is not locally productive of oil or gas.
c. The formation water in the disposal zone has a total dissolved solids content greater than 20,000 mg/L.

2.0 Disposal of Sump Fluids on the Lease

Disposal of sump fluids to the lease is an acceptable procedure providing all of the following conditions are met:

a. Notice of at least 1 week has been given to:

   i. the appropriate District Office of Alberta Energy and Natural Resources if the well was drilled on any public land in the Province.
   ii. the appropriate Area Office of the Energy Resources Conservation Board if the well was drilled on any other lands not specified in section 2.0 (a).

b. The entire contents of the sump are confined to the lease.
c. The sump(s) contain less than a total of 950 m^3 of fluid. Not withstanding this limitation, approval may be given by the Board or Alberta Energy and Natural Resources to dispose of more than 950 m^3 of fluid to the lease providing it can be shown that the entire contents of the sump will be confined to the site. Applications for such approval shall be directed, in the appropriate case, to either the Area Office of the Energy Resources Conservation Board or District Office of Alberta Energy and Natural Resources.
d. The lease is more than 90 m from the normal high water mark of a body of water, permanent stream or potable water well.
e. The lease site will, in the opinion of the Energy Resources Conservation Board or Alberta Energy and Natural Resources, accept the sump contents, to be disposed, without runoff.

3.0 Disposal of Sump Fluids Off The Lease

3.1 Disposal of sump fluids to off-lease land areas is an acceptable procedure providing:

a. The sump fluids meet the following criteria:

Chloride Content	1000 mg/L Maximum
Sulfate Content	2000 mg/L Maximum

Total Dissolved Solids	4000 mg/L Maximum
pH	5.5 to 8.5
Trout Survival Test	96 Hrs. (see Appendix "C2" - Guidelines Used to Determine Fish Toxicity Tests on Sump Fluids).

b. Approval to dispose off the lease has been obtained in accordance with section 3.3.

3.2 The Energy Resources Conservation Board or Alberta Energy and Natural Resources will consider off-lease disposal which is not according to the criteria outlined in section 3.1. Application shall be made in the appropriate case, to the Area Office of the Energy Resources Conservation Board or the District Office of Alberta Energy and Natural Resources.

3.3 Off-Lease Disposal Approval

3.3.1 On public lands throughout the Province, the disposal of well sump fluids to land off the lease, and the location of the disposal site, must be approved by the appropriate District Office of Alberta Energy and Natural Resources.

3.3.2 On all land not described under subsection 3.3.1, disposal of well sump fluids to land off the lease must be approved by the Energy Resources Conservation Board, subject to the disposal and disposal site having been approved by the landowner.

3.3.3 Any licensee of a well who intends to dispose of fluids to land off the lease area shall:

a. sample the fluids according to the procedure outlined in Appendix C1.

b. analyze and field-treat the sump fluids so that the fluid to be disposed of meets the criteria outlined in section 3.1. Tests must conform to the guidelines outlined in Appendix C2.

c. two days prior to treating the fluids and depending on whether the lease is located on public or other lands, notify, in the appropriate case, the District Office of Alberta Energy and Natural Resources or the Energy Resources Conservation Board.

3.3.4 The request for approval to dispose of sump

fluids to land off the lease area must be submitted, in the appropriate case, to the District Office of Alberta Energy and Natural Resources or the Area Office of the Energy Resources Conservation Board, and contain the following information:

a. a description of the sampling procedure.
b. a general description of the method of treatment of the sump fluids.
c. an analysis of a representative sample of the treated sump fluids (including trout survival test).
d. the location of the disposal area and the volume of sump fluids to be disposed of.
e. a brief description of the surrounding area (i.e. whether it is forested, muskeg, swamp and the kind of vegetation present).
f. in the case of disposal to private lands, a statement that the landowner's permission has been obtained to dispose to the off-lease site.

3.4 Disposal of well sump fluids to any surface water either directly or indirectly by land surface drainage must be approved by Alberta Environment. Only under rare circumstances, and where sufficient lease land or peripheral land disposal sites are not available, is such disposal considered.

APPENDIX C1

GUIDELINES FOR OBTAINING A REPRESENTATIVE SAMPLE OF THE SUMP FLUIDS

1. Divide the sump into six segments and then obtain samples near the surface, middle and bottom of each segment. In this way 18 samples will be obtained to form a single composite sample.

2. The minimum composite sample size is 3 L collected in a glass or plastic container.

3. The sample should be submitted for analysis to a reliable commercial laboratory.

APPENDIX C2

GUIDELINES USED TO DETERMINE FISH TOXICITY TESTS ON SUMP FLUIDS

Drilling sump fluids may contain a variety of complex organic and inorganic compounds, the combined effects of which are difficult to ascertain. Therefore, the fish survival test is being used as a part of the criteria to evaluate the toxicity of treated sump fluids.

The person carrying out the test may be reasonably certain that if any fish survives the 96 hour test the treated sump fluids are minimally toxic. However, if both fish die within a very short period of exposure to the treated sump fluids, then further treatment of the fluids is necessary. In cases where it appears that problems are being experienced with fluid detoxification, the ERCB's Chief Chemist should be consulted.

Requirements of the standard bioassay tests apply as stated in the latest edition of Standard Test Methods[1] except for those points mentioned below:

1. The test fish to be used are small trout fingerlings 4 to 10 centimeters in length, which have been living in standard dilution water[2].

2. Two fish are to be used per test.

3. Test fish are not to be used for more than one test during their life-time.

4. A minimum of 1 litre of the test water is required.

5. The test water container is to be of glass and of a minimum capacity of approximately 2 litres.

6. A control test is to be carried out (using standard dilution water) simultaneously with the actual sump fluid test.

7. Dissolved oxygen in the control and test jars is to be maintained at a minimum of 8 mg/litre.

---

1 Standard methods for the examination of water and waste water. Thirteenth edition 1971, APAJ, AWWA, WPCF. American Public Health Association, 1015-18 St. N.W. Washington, D.C. 20036.

2 Standard dilution water:

For every 45.4 L of demineralized water, add the following reagent grade chemicals:

1. 4 grams $CaSO_4.SH_2O$
2. 4 grams $MgSO_4.7H_2O$
3. 1.5 grams $CaCl_2.2H_2O$
4. 3.0 grams $NaHCO_3$
5. .2 grams KCl
6. .125 grams $Ca(OH)_2$
7. .125 grams $Mg(OH)_2$

APPENDIX D

Metric/Imperial Table*

	METRIC MEASUREMENT	IMPERIAL MEASUREMENT
Page vii	90 000 km^2	35 000 sq. miles
Page 1	8 m	25 ft.
	3 m	8 ft.
	45 m	150 ft.
	1 km	one-half mile
	90 m	300 ft.
	5 m	16 ft.
Page 2	6 m x 12 m	20' x 40'
	30 m x 30 m	100' x 100'
	10 m	30 ft.
Page 3	45 m	150 ft.
	15 m to 90 m	50' to 300'
Page 4	3 m	8 ft.
	30 m	100 ft.
Page 5	15 m	50 ft.
	25 trees/any ha	10 trees/any acre
Page 6	6 m	20 ft.
	2 000 m^2	one-half acre
Page 7	90 m	300 ft.
	1 km	one-half mile
	$15.55/km	$25 per mile
	10 cm	4 in.
	60 m	200 ft.
	8 m	25 ft.
Page 8	30 cm	12 in.
Page 10	$18.65/km	$30.00 per mile
Page 11	60 m	200 ft.
	45 m	150 ft.
	30 m	100 ft.
	15 m	50 ft.
Page 13	40 cm	16 in.
Page 14	15 cm to 20 cm	6-8 in.
Page 19	6 m	20 feet
	320 m^3	2 000 barrel
Page 20	90 m	100 yds.
Page 21	90 m	300 ft.
Page 22	15 m	50 ft.
Page 24	8 m	25 ft.
	60 m	200 ft.
Page 25	30 m	100 ft.
	15 m	50 ft.
	1 m	4 ft.
	0.5 m	2 ft.

	METRIC MEASUREMENT	IMPERIAL MEASUREMENT
Page 26	15 cm	6 in.
Page 28	$18.65/km	$30.00 per mile
Page 30	4 m^2	5 sq. yds.
Page 36	15 cm	6 inches
Page 38	15 m	50 ft.
	25 trees/ha	10 trees/any acre
Page 39	12 m	40 ft.
Page 42	25 kg/ha	25 lbs. per acre
	160 kg/ha	150 lbs. per acre
Page 45	950 m^3	6 000 barrels (of fluid)
	90 m	300 ft.
Page 48	3 L	2 qts. (of fluid)
Page 49	45.4 L	10 imperial gallons
Page 52	2 m to 1 m	2 ft. to 1 ft.
	3 m to 1 m	3 ft. to 1 ft.

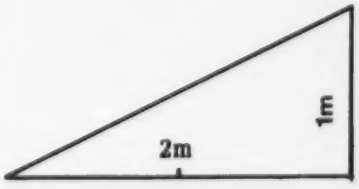
* Not to be used as an exact conversion table.

APPENDIX E

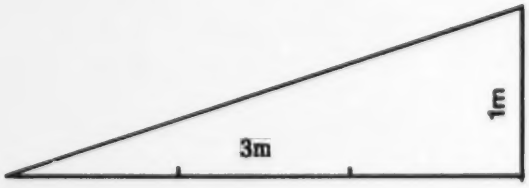
CONVERSION TABLE FOR CHANGING DEGREES TO PERCENT

DEGREES	PERCENT	DEGREES	PERCENT
8	14	27	51
9	16	28	53
10	18	29	55
11	19	30	58
12	21	31	60
13	23	32	62
14	25	33	65
15	27	34	67
16	29	35	70
17	30	36	73
18	32	37	75
19	34	38	78
20	36	39	81
21	38	40	84
22	40	41	87
23	42	42	90
24	44	43	93
25	46	44	96
26	49	45	100

Backsloping



2 to 1



3 to 1